Clinical Article

Online ISSN : 2314-8969
Print ISSN: 2314-8950

Egy Spine J 25:47-53, 2017

www.esa.org.eg

Instrumented Posterolateral Spinal Arthrodesis as an Effective Treatment for Single Level Symptomatic Vacuum Lumbar Disc Degeneration in Elderly Patients

Waeel Hamouda, MD.

Neurosurgery Department, Cairo University Medical School and Teaching Hospitals, Egypt.

Abstract

Background Data: Lumbar intervertebral disc vacuum phenomenon is an advanced form of spinal destabilizing degenerative changes. It is common in the elderly population and can cause refractory low back pain.

Purpose: To evaluate the efficacy and safety of instrumented posterolateral fusion in treating symptomatic lumbar single level vacuum phenomenon in elderly population.

Study Design: Retrospective descriptive clinical case series.

Patients and Methods: Twenty-one patients (16 males & 5 females), aging more than 65 years, had all their files reviewed. They were operated by instrumented posterolateral fusion to treat chronic refractory low back pain due to single level intervertebral lumbar disc vacuum phenomenon. They underwent operation after failure of adequate 6 months conservative management. Age, gender, symptoms duration, spinal level affected, surgery duration, length of hospital stay, intra or post-operative complications, visual analogue scale VAS for pain, and Lenke's graft fusion classification at 1, 3 & 6 months postoperatively were all recorded.

Results: The results of this study showed the most affected level was L4/L5, mean age was 73±7 years, mean symptoms duration was 11 years, mean surgery duration was 137±29 minutes, and mean VAS for preoperative-postoperative pain improvement was 5.9±1.2. Good fusion (Lenke's grades A & B) was reported in 81% of patients. No major intra or postoperative complications.

Conclusion: Instrumented posterolateral fusion in elderly population patients with mono-segmental advanced disc degeneration may yield clinical outcome with low operative risk. (2017ESJ150)

Keywords: posterolateral; arthrodesis; lumbar spine; vacuum phenomenon; elderly

Introduction

"The intervertebral vacuum phenomenon" a term first described by Magnusson in 1937,[28] refers to a radiographic finding of gas within the intervertebral disk. It is usually correlated with advanced intervertebral disc degeneration,[19] leading to instability of the affected vertebral motion segment that usually results in chronic persistent back pains[18]. It is most commonly encountered in lumbar spine of elderly patients.[12]

For patients where conservative treatments fail to control their low back pains, the affected vertebral

Received on:
July 29th, 2017
Accepted on:
December 2nd, 2017

motion segment fusion is mandated. Surgical options include posterolateral intertransverse (PLF) or posterior lumbar interbody fusion (PLIF) approaches[8,1]. Although PLIF has sound biomechanical advantages,[29] it is associated -if compared with the posterolateral intertransverse fusion- with relatively longer operating times and more intraoperative bleeding,[27] risks which should be taken in consideration while planning surgical intervention in the vulnerable elderly patients. The PLF fusion rates improved with the help of pedicle-screw instrumentation to reach 75% fusion rate, and the clinical outcome to 80% good to excellent clinical outcome.[4,11]

The purpose of this study was to report the clinical and radiological outcomes of PLF in elderly patients with low back pain due to monosegmental lumbar intervertebral disc vacuum phenomenon.

Patients and Methods

Retrospectively, our hospital's medical records of patients aging above 65 years, who were operated upon during the period from July 2010 till December 2015 were reviewed. We enrolled those patients who had single level lumbar posterolateral fusion augmented by transpedicular screw fixation. This approach was used as a surgical management for chronic progressive refractory low back pain, secondary to advanced degenerative intervertebral disc disease, associated with vacuum phenomenon (gas detected within the intervertebral disc space in X-rays or computed topography CT). Patients with degenerative spondylolisthesis as evident in dynamic lumbosacral spine X-ray studies, degenerative scoliosis, previous lumbar spine surgeries, those presenting mainly with sciatica or neurogenic claudication, or those who failed to comply to regular follow up visits for the first six months postoperatively were not included. All included patients should have tried conservative non-surgical managements for at least a period of 6 months without satisfactory relieve of their pain prior to considering surgery. These non-surgical managements included medications, physiotherapy and ergonomic exercises, weight reduction program if mandated, as well as trials of local spine injections. Records were analysed for age, gender, duration of symptoms, associated other less manifesting pains of spinal origin, spinal level affected, duration of surgery, length of postoperative hospital stay, and intra or postoperative complications if any.

Surgical technique involved standard transpedicular screw fixation with rods, along with intertransverse posterolateral fusion using demineralized allografts (MTF™ Company) after decortication of the posterolateral surfaces of the relevant transverse processes and pars interarticularis. (Figure 1) Neural decompression to resolve associated radiculopathy when mandated was done via either laminotomy, laminectomy, discectomy or osteophytictomy. Patients in the series who were suffering from associated femoralgia and sciatica, had undergone interlaminar fenestration with the involved nerve root decompression and patients with neurogenic claudication undergone laminectomy.

Recorded Visual Analogue Scale (VAS) was used to assess low back pain one day preoperatively, as well as at one, three and six months postoperatively. Lumbar spine standing anteroposterior and lateral view radiographs at the three and six months follow-up visits were used to determine the bone graft fusion state using the Lenke's[25] classification based on the size, discontinuity, and resorption of the fusion mass created between the upper and lower transverse processes, where grades A and B are defined as the union state, and grades C and D are defined as the non-union state.

Data were analysed using the SPSS version 13.0 statistical software package (SPSS Inc., Chicago, IL, USA). The continuous variables are presented as mean ± standard deviation.

Results

Twenty-one patients were identified. Sixteen were males and five were females. Mean age was 73±7 (Range, 65-86) years. Average duration of symptoms was 11 years. Main presenting pain was chronic low back pain which manifests more at waking up in the morning, after prolonged standing or walking for few meters. Three patients suffered from symptoms other than low back pain including; one femoralgia, one sciatica, and one neurogenic claudication. All three patients reported -during history recording-

that although theses pains were initially the leading complains but later became less prominent with progression of their significant low back pain and eventually limitation of ambulation.

Most lumbar spinal levels affected was L4/5 (10 patients), L5/S1 (6 patients), L3/4 (4 patients) and L1/2 (1 patient). Mean duration of surgery was 137±29 (Range,102-185) minutes, and mean postoperative stay was 4±2 (Range, 2-7) days. One patient needed intraoperative blood transfusion as he was maintained perioperatively on Clopidogrel for recent coronary stenting, and another patient had a dural tear during performing discectomy, which was sutured and sealed primarily with no postoperative sequelae.

The mean preoperative VAS for back pain was 7.8±0.8, at 3 months postoperatively was 3.6±0.5, and at the six months' final follow-up it improved to 1.9±0.6. Radiologic fusion (Lenke's grades A & B) was observed in 17 patients by the 6th month postoperatively (81%), incomplete fusion (Lenke's grades C & D) was noted in two male and two female patients with no implication on VAS pain improvement. Results are summarized and presented in table 1.

Table 1. Data Summary of 21 Patients Reported in this Study.

Case No.	Gender	Age/ years	Duration of Symptoms/ years	Spinal level affected	Associated symptoms other than back pain	Operative Time/ minutes	operative events	Hospital stay/ days	Preoperative VAS	3 months postoperative VAS	6 months postoperative VAS	Lenke's fusion grade 6 months postoperative
1	M	82	10	L4/L5		102		2	8	4	2	A
2	F	77	14	L4/L5		117		5	7	3	2	B
3	M	66	9	L5/S1	Sciatica	171	Dural tear	7	9	5	3	A
4	M	68	7	L4/L5		108		2	8	4	2	B
5	M	76	16	L1/L2		105		5	8	3	1	A
6	F	79	14	L5/S1		162		2	7	4	2	C
7	M	72	18	L4/L5		169		6	7	3	1	C
8	M	66	10	L5/S1		117		5	9	4	2	A
9	M	83	11	L3/L4		156		2	7	4	3	B
10	M	73	12	L5/S1		110		2	8	4	3	A
11	M	65	15	L3/L4	Femoralgia	162		6	9	4	1	B
12	F	86	9	L4/L5		155		2	8	4	2	A
13	F	66	6	L4/L5		162		7	8	3	2	B
14	M	74	14	L4/L5		105		5	8	4	2	A
15	M	66	6	L5/S1		158		6	7	3	2	C
16	M	75	16	L3/L4		110		3	8	3	1	B
17	M	72	10	L4/L5		106		2	8	3	2	A
18	M	70	7	L4/L5		104		5	7	4	2	A
19	F	65	10	L5/S1		165		2	6	3	2	D
20	M	67	9	L3/L4	Claudication	185	Blood transfusion	7	8	4	2	B
21	M	85	8	L4/L5		150		2	9	4	1	A

(M: male, F: female, VAS: visual analogue scale)

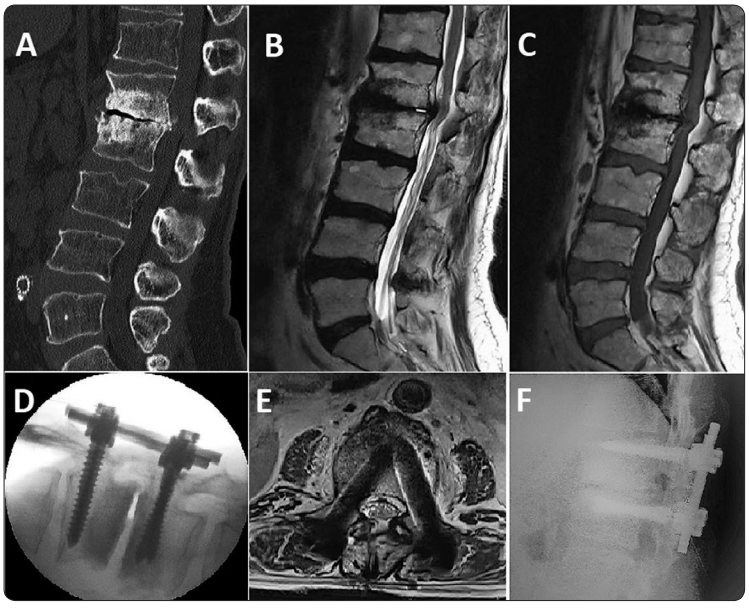

Figure 1. An illustrative case of 73 years old male patient presenting mainly with slowly progressive long standing back pain with intermittent thigh claudications, refractory to conservative management. (A) Preoperative mid-sagittal CT scan image showing advanced L1-L2 degenerative intervertebral disc disease associated with vacuum phenomenon (Jet black gas detected within the intervertebral space), with adjacent opposing endplates sclerotic changes. (B) & (C) Preoperative mid-sagittal MRI T2 & T1 images respectively, showing Modic type 3 changes. (D) Intraoperative fluoroscopic images showing single level posterior transpedicular screws/rods construct (note the hypodense opposing endplates shadows denoting bone sclerosis). (E) Postoperative axial MRI T2 images showing laminectomy done to relieve claudications caused by acquired lateral recesses stenosis from endplates osteophytes lipping. (E) Follow up X-ray lateral view image after 6 months from surgery, showing intertransverse fusion mass (Lenke's garde A), with marked reduction of the patient's back pain.

Discussion

"The intervertebral vacuum phenomenon" as described,[28] refers to visualizing gas within the intervertebral disk space on radiographic images. Its presence correlates with end stage intervertebral disc degeneration,[19] where disc dehydration and shrinkage leads to clefts formation within the nucleus pulposus, which accumulate gas from the surrounding tissues.[5] Because of the lack of material inside the vacuum disc, it doesn't contribute to the support of the involved motion segment.[14,15] It has also demonstrated a close relationship with pathological sagittal translation.[17] Both these factors are important signs of vertebral motion segment instability that results in prominent back pain.[18,20]

Vacuum phenomenon is a common finding especially in the lumbar spine. Although it is observed in about 1–3% of all lumbar radiographs, about 50% of the patients with this condition are older than 40 years of age.[23] With further age advancement it becomes much more common and reaches a much higher prevalence of almost 25% in the elderly.[12,30] So It is not uncommon to see vacuum discs in x-rays of elderly patients seen in clinics complaining of longstanding significant low back pain.[26] In this study the mean age of the included patients was 73 years.

For patients where non-surgical treatments failed to alleviate their persistent low back pains, fusion of the affected motion segment is recommended. Surgical approaches may include those that employs interbody fusion (e.g. anterior lumbar interbody fusion ALIF, posterior lumbar interbody fusion PLIF, and transforaminal lumbar interbody fusion TLIF) and those that don't (posterolateral "intertransverse" fusion PLF), or a combination of both, with all approaches usually accompanied by transpedicular screw instrumented fixation to enhance fusion rates.

Theoretically, the degenerated vacuum disc would continue to move persistently if an interbody fusion was not performed, resulting in a less favourable surgical outcome.[25,33] posterior lumbar interbody fusion techniques is expected to achieve better clinical results than posterolateral fusion (PLF) as it support the anterior column, regain disc height, correct sagittal alignment, and can maintain lordosis.[29,31] PLIF also presumed to have better bone graft fusion after debridement of the degenerated lumbar disc endplates.[24]

However, interbody fusion approaches involve more neural tissues manipulation and retraction (e.g. PLIF & TLIF), higher risk for dural tears, more postoperative tissue scarring, requires a longer

operating time, and can be associated with greater blood loss.[2,10,27] The latter two drawbacks can be of utmost importance when planning to operate on and elderly patient. Although some surgeon have advocated minimally invasive interbody fusion techniques to overcome these drawbacks,[3] there are concerns that even if utilized, these minimally invasive techniques might escalade the risk of nerve roots injury [9] with seemingly no -at least- obvious added benefits in other studies.[13]

In this study, the most commonly affected spinal levels were L4/5 followed by L5/S1, similar to incidence reported by Deukmedjian et al,[6] and D'Anastasi et al,[5] but opposite to Ki-Chan et al,[2] where incidence of L5/S1 affection level was higher. The Mean duration of the instrumented PLF surgeries was 137±29 minutes, shorter than reported in other instrumented PLF series, as reported by An et al,[3] in their series of 46 patients where mean operative time was 163±42, and significantly shorter than time reported for single level open TLIF or PLIF surgeries in other studies[7,28] with mean operative time 237 and 198 minutes respectively.

Adequate radiologic bone fusion (Lenke's A & B) was observed in 81 % of the patients after six months. Similar percentages were mentioned in meta-analysis studies conducted by Jacobs et al,[16] and Kwon et al,[22] for instrumentation- augmented PLF, where good clinical outcome was documented with this rate of PLF fusion. Although lumbar interbody fusion techniques might yields higher fusion rates, still the clinical outcome with PLF is not compromised.[2,21,32]

In the studied patients, the reduction of the mean VAS for back pain after six months postoperatively was 5.9±0.2. This is comparable to similar improvement in other instrumented PLF or PLIF/TLIF/ALIF series,[3,2,4,32] with mean VAS reduction of 4.8±1.2, 5.2±1.1, 3.6±0.9, and 4.4±1.2 respectively.

The study excluded patients with degenerative spondylolisthesis and similarly scoliosis, as these patients usually harbour other instability-related degenerative changes other than those solely attributed to the intervertebral discs, i.e. increases ligamentous laxity and chronic facet joint arthropathy. So, results and recommendations driven from this study shouldn't be reproduced with confidence to these groups of patients.

The study has some limitations; it was retrospective and had a narrow spectrum of inclusion criteria, which might lead to selection bias. The number of patients reviewed was relatively small, and some of the operated patients missed few or all of the follow-up visits. Also, patient characteristics like smoking, disease, and bone mineral density were not investigated.

Conclusion

Instrumented posterolateral fusion in elderly population patients with mono-segmental advanced disc degeneration may yield clinical outcome with low operative risk.

References

1. Abdel-Ghany MI, El-Wardany M, Kabil M, Abdel-Salam AI, Atallah A-HA, Abdel-Gawad HM: Posterior lumbar interbody fusion (PLIF) Versus Inter-transverse Posterolateral Fusion (PLF) for Treatment of Lumbar Spondylolisthesis: a Comparative Study. Egyptian Spine Journal 11:18-25, 2014
2. An K-C, Kong G-M, Park D-H, Baik J-M, Youn J-H, Lee W-S: Comparison of Posterior Lumbar Interbody Fusion and Posterolateral Lumbar Fusion in Monosegmental Vacuum Phenomenon within an Intervertebral Disc. Asian Spine J 10(1):93-98, 2016
3. Asher AL: Benefit of Transforaminal Lumbar Interbody Fusion vs Posterolateral Spinal Fusion in Lumbar Spine Disorders. 79(3):397-405, 2016
4. Booth KC, Bridwell KH, Eisenberg B a, Baldus CR, Lenke LG: Minimum 5-year results of degenerative spondylolisthesis treated with decompression and instrumented posterior fusion. Spine (Phila Pa 1976) 24(16):1721-1727, 1999
5. D'Anastasi M, Birkenmaier C, Schmidt GP, Wegener B, Reiser MF, Baur-Melnyk A: Correlation between vacuum phenomenon on CT and fluid on MRI in degenerative disks. Am J Roentgenol (197):1182-1189, 2011

6. Deukmedjian AJ, Cianciabella AJ, Cutright J, Deukmedjian A: Combined transforaminal lumbar interbody fusion with posterolateral instrumented fusion for degenerative disc disease can be a safe and effective treatment for lower back pain. J craniovertebral junction spine 6(4):183-189, 2015
7. Dhall SS, Wang MY, Mummaneni P V: Clinical and radiographic comparison of mini–open transforaminal lumbar interbody fusion with open transforaminal lumbar interbody fusion in 42 patients with long-term follow-up. J Neurosurg Spine 9(6):560-565, 2008
8. El-Sharkawi M, Koptan W, Elmiligui Y: Transforaminal Lumbar Interbody Fusion (TLIF) for Revision of Failed Posterolateral Spinal Fusion. Egypyian Spine Journal 2:1-9, 2012
9. Epstein NE: More nerve root injuries occur with minimally invasive lumbar surgery, especially extreme lateral interbody fusion: A review. Surg Neurol Int 7(Suppl 3):S83-95, 2016
10. Farrokhi MR, Rahmanian A, Masoudi MS: Posterolateral versus Posterior Interbody Fusion in Isthmic Spondylolisthesis. J Neurotrauma 29(8):1567-1573, 2012
11. Fischgrund JS, Mackay M, Herkowitz HN, Brower R, Montgomery DM, Kurz LT: 1997 Volvo Award winner in clinical studies. Degenerative lumbar spondylolisthesis with spinal stenosis: a prospective, randomized study comparing decompressive laminectomy and arthrodesis with and without spinal instrumentation. Spine (Phila Pa 1976) 22(24):2807-2812, 1997
12. Gershon-Cohen J: The phantom nucleus pulposus. Am J Roentgenol Radium Ther 55:43-48, 1946
13. goldstein christina, Macwan K, Sundararajan K, Rampersaud R: Perioperative outcomes and adverse events of minimally invasive versus open posterior lumbar fusion: meta-analysis and systematic review. J Neurosurg Spine 24:416–427, 2016
14. Hasegawa K, Shimoda H, Kitahara K, Sasaki K, Homma T: What are the reliable radiological indicators of lumbar segmental instability? J Bone Joint Surg Br 93(5):650-657, 2011
15. Iguchi T, Ozaki T, Chin T, Tsumura N, Kanemura A, Kasahara K, et al: Intimate relationship between instability and degenerative signs at L4/5 segment examined by flexion-extension radiography. Eur Spine J 20(8):1349-1354, 2011
16. Jacobs WCH, Vreeling A, De Kleuver M: Fusion for low-grade adult isthmic spondylolisthesis: A systematic review of the literature. Eur Spine J 15(4):391-402, 2006
17. Kanemura A, Doita M, Kasahara K, Sumi M, Kurosaka M, Iguchi T: The influence of sagittal instability factors on clinical lumbar spinal symptoms. J Spinal Disord Tech 22(7):479-485, 2009
18. Kasai Y, Takegami K, Uchida A: Change of barometric pressure influences low back pain in patients with vacuum phenomenon within lumbar intervertebral disc. J Spinal Disord Tech 15(4):290-293, 2002
19. Knutsson F: The vacuum phenomenon in the intervertebral disc. Acta Radiol 23:173-179, 1942
20. Kumpan W, Salomonowitz E, Seidl G, Wittich GR: The intravertebral vacuum phenomenon. Skeletal Radiol 15(6):444-447, 1986
21. Kuraishi S, Takahashi J, Mukaiyama K, Shimizu M, Ikegami S, Futatsugi T, et al: Comparison of Clinical and Radiological Results of Posterolateral Fusion and Posterior Lumbar Interbody Fusion in the Treatment of L4 Degenerative Lumbar Spondylolisthesis. Asian Spine J 10(1):143-152, 2016
22. Kwon BK, Hilibrand AS, Malloy K, Savas P E, Silva M T, Albert T, et al: A critical analysis of the literature regarding surgical approach and outcome for adult low-grade isthmic spondylolisthesis. J Spinal Disord Tech 18 Suppl:S30-40, 2005
23. Larde D, Mathieu D, Frija J, Gaston A, Vasile N: Spinal vacuum phenomenon: CT diagnosis and significance. J Comput Assist Tomogr 6(4):671-676, 1982
24. Lau D, Lee JG, Han SJ, Lu DC, Chou D: Complications and perioperative factors associated with learning the technique of minimally invasive transforaminal lumbar interbody fusion (TLIF). J Clin Neurosci 18(5):624-627, 2011

25. Lee CK, Vessa P, Lee JK: Chronic disabling low back pain syndrome caused by internal disc derangements. The results of disc excision and posterior lumbar interbody fusion. Spine (Phila Pa 1976) 20(3):356-361, 1995
26. Lenke LG, Bridwell KH, Bullis D, Betz RR, Baldus C, Schoenecker PL: Results of in situ fusion for isthmic spondylolisthesis. J Spinal Disord 5(4):433-442, 1992
27. LT F, FG G: X-ray studies of the lumbosacral spine. South Med J 59:1123-1128, 1966
28. Madan S, Boeree NR: Outcome of posterior lumbar interbody fusion versus posterolateral fusion for spondylolytic spondylolisthesis. Spine (Phila Pa 1976). 27(14):1536-1542, 2002.
29. Magnusson W: Der Wirklichen Gelenkspalte Auf Dem Röntgenbilde : Acta Radiol 18:733–741, 1937
30. Okuyama K, Kido T, Unoki E, Chiba M: PLIF with a titanium cage and excised facet joint bone for degenerative spondylolisthesis--in augmentation with a pedicle screw. J Spinal Disord Tech 20(1):53-59, 2007
31. Resnick D, Niwayama G, Guerra J, Vint V, Usselman J: Spinal vacuum phenomena: anatomical study and review. Radiology 139(2):341-348, 1981
32. Sudo H, Oda I, Abumi K, Ito M, Kotani Y, Minami A: Biomechanical study on the effect of five different lumbar reconstruction techniques on adjacent-level intradiscal pressure and lamina strain. J Neurosurg Spine 5(2):150-155, 2006
33. Ye Y, Xu H, Chen D: Comparison between posterior lumbar interbody fusion and posterolateral fusion with transpedicular screw fixation for isthmic spondylolithesis: a meta-analysis. Arch Orthop Trauma Surg 133:1649-1655, 2013
34. Yu CH, Wang CT, Chen PQ: Instrumented posterior lumbar interbody fusion in adult spondylolisthesis. Clin Orthop Relat Res 466(12):3034-3043, 2008

Address reprint request to:

Waeel Hamouda, MD.
Neurosurgery Department, Cairo University Medical School and Teaching Hospitals, Egypt - Email: wohamouda@outlook.com

الملخص العربي

الالتحام الفقري الخلفي الجانبي باستخدام البراغي كعلاج فعال لأعراض التدهور الفارغ للقرص القطني أحادي المستوى لدى المرضى المسنين

البيانات الخلفية: ظاهرة القرص القطني الفارغ هيئة متقدمة للتغيرات الفقرية المتدهورة الغير مثبته بالمسنين المتسببة بآلام أسفل الظهر العنيدة.

الغرض: دراسة فاعلية وسلامة الالتحام الفقري الخلفي الجانبي بمساندة الآلات لأعراض التدهور الفارغ للقرص القطني أحادي المستوى.

تصميم الدراسة: دراسة بأثر رجعى

المرضي والطرق: 21 مريض (16 ذكر و5 إناث) بعمر أكبر من 65 سنة أجروا جراحة للإلتحام الفقري الخلفي الجانبي بمساندة الآلات كعلاج لآلام أسفل الظهر المزمنة العنيدة نتيجة التدهور الفارغ للقرص القطني اللذين فشل علاجهم بدون جراحة لمدة 6 أشهر، تم مراجعة ملفاتهم. تم تسجيل السن، الجنس، مدة الاعراض، المستوى الفقري المتأثر، مدة الجراحة، مدة البقاء بالمستشفى، المضاعفات أثناء أو بعد الجراحة، مقياس الألم البصري, و تصنيف Lenke's لالتحام الرقعة عند 1و3 و6 أشهر بعد الجراحة.

النتائج: متوسط السن 73±7 سنوات و مدة الأعراض 11 سنة، مدة الجراحة 137±29 دقيقة، و مقياس الألم 5.9±1.2 . المستوى الأكثر تأثرا L4/L5 . التحام جيد 81% (Lenke's A&B) . لا مضاعفات أثناء أو بعد الجراحة.

الاستنتاج: الالتحام الفقري الخلفي الجانبي بمساندة البراغي بالمسنين للتحكم بآلام أسفل الظهر المزمنة العنيدة نتيجة التدهور الفارغ المتقدم للقرص القطني أحادي المستوى له نتائج وظيفية جيدة ومخاطر جراحية منخفضة.